

Predation of *Desmodus rotundus* Geoffroy, 1810 (Phyllostomidae, Chiroptera) by *Epicrates cenchria* (Linnaeus, 1758) (Boidae, Reptilia) in an Ecuadorian Cave

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Abstract

Bats are mammals of the Order Chiroptera. They are highly adaptable to several habitats and their ecology makes them vulnerable to predators. Bats are a common prey of snakes, but description of this kind of predation are rare. This study describes the event of predation of an *Epicrates cenchria* on a *Desmodus rotundus*, in a cave in Tena, Ecuador. Records of *Desmodus rotundus* are known from caves just as *Epicrates cenchria*. Castillo Cave has a total mapped length of 450 meters. The phase of constriction lasted for 10 min 2 s, a duration superior than other studies, due to the size of *Desmodus rotundus*. The terrestrial locomotion behavior of *D. rotundus*, makes it an easy target for *E. cenchria*. The predation event occurred on the floor, a rare case, which has not been described in other events of predation in caves. The cave is located in a disturbed habitat, because it is irrigated by wastewaters. But both species seems to be adapted to the environment. This study confirms that predation of bats in caves by snakes does occur.

Keywords

Bat predation, boids, behavior, attack

Introduction

Bats are mammals of the Order Chiroptera. They are highly adaptable to several habitats: trees (Jachowski et al. 2016), under plantain leaves (Rodríguez-Herrera et al. 2011), caves (Zortea et al. 2015), human settlements (Whitaker et al. 2006, Streicker et al. 2013), etc. Like most animals, they are not predator free. There is a list of enemies mentioned in the literature: monkeys, loris, mustelids (weasels), minks (Goodpaster and Hoffmeister 1950), raccoons, opossums, cats and even bats themselves. Mikula (2015) recently published a literature review of different fishes (such as salmon, catfishes and sharks) that prey on bats; and amphibians such as Bufonidae, Hylidae and Leptodactylidae, prey on bats too. Giant centipedes were also observed killing bats in a cave in Venezuela (Molinari et al. 2005). Spiders have been recently suggested that their predation on bats is not that uncommon (Nyffeler and Knörnschild 2013). But the most common predators are birds and snakes (Hill and Smith 1984, Mickleburgh et al. 1992). Within birds we can mention raptors such as *Accipiter tachiro*, *Aquila walhbergi*, *Falco subbuteo*, hawks (Lee and Kuo 2001) and owls (Julian and Altringham 1994) such as *Asio stygius* (Motta Junior and Taddei 1992), and *Tyto alba* (Vargas et al. 2002), but there are events of other types of birds such as *Momotus momota* preying on a bat (Chacón-Madrigal and Barrantes 2004). Within snakes we can mention the case reported by Hammer and Arlettaz (1998), another in western Iran by a Colubridae (Sharifi et al. 2014). Esbérard and Vrcibradic (2007) made a review of recorded cases for the neotropical region, but we can also name a more recent case of *Hemorrhoids hippocrepis* preying on *Plecotus austriacus* and on *Eptesicus serotinus* (Schreber, 1774) / *Eptesicus isabellinus* (Temminck, 1839) (Garrido-García et al. 2013). Two observations were reported in caves in Mexico where snakes caught bats hanging off the roof (BBC 2014, BBC Earth 2014).

Desmodus rotundus (common vampire) is one of three sanguivorous bat species (Simmons 2005, Kwon and Gardner 2007), that habits mainly in caves but also can be found in tree holes (Pozo and Cueva pers. comm.). Normally they attack their prey flying stealthy and perching on the dorsal face of large mammals like cows, tapirs, deer and peccaries (personal observations). *D. rotundus* is distributed from North of Tamaulipas and Sonora (México) to Uruguay, northern Argentina and central Chile (Greenhall et al. 1983). In Caribbean Islands is found only in Trinidad (Mancina, pers. com.) and Margarita Islands (Wilson and Reeder 2005). Ecuadorian subspecies belong to *Desmodus rotundus rotundus* (Greenhall et al. 1983) which it has been recording in all geographic altitudes zones (Albuja-V et al. 2012). *Desmodus* in the day rests perching on the roof of the caves, but occasionally are found walking on the floor when they are accidentally dropped from roof (Wilmer E. Pozo-Rivera Observations). Over the floor *Desmodus* recently awake, walk helping with their legs and elbows.

Epicrates seems to be a major threat to bats on the neotropics. Half of the records published on the review made by Esbérard and Vrcibradic (2007) involving boid snakes species were *Epicrates* sp. *Epicrates cenchria* is endemic to Central and South America (McDiarmid et al. 1999). Ecuador has the subspecies *Epicrates cenchria gaigei* (Uetz and Hallermann 2016). It is described as a medium sized (Duellman 1978, Ross and Marzec 1990) terrestrial nocturnal snake (Savage 2002). Characterized by having a blue iridescence in sunlight, this viviparous snake was found in primary and secondary forest, on the ground and on the trees (Duellman 1978). But is also very common to find this species close to rivers where food is abundant (Gonzálves 2006). Birds, rodents, and bats (Lemke 1978, Medeiros de Pinho et al. 2009, Pizzatto et al. 2009) are common preys of *Epicrates cenchria*.

We report the first record of predation of *Desmodus rotundus* (Common Vampire Bat) by *Epicrates cenchria* (Rainbow Boa) in a cave in Ecuador.

Methods

The predation event was observed in the late afternoon of the 5th of December 2015 during 25 minutes and mostly filmed during the regular cave monitoring of the Castillo Cave, near the city of Tena, in Napo province (Fig 1).

Geological setting of Castillo Cave

The area around the city of Tena is predominantly covered with deposits (200-700 m) of the Napo Formation, which consists of cyclic sequences of limestones, shales, and sandstones deposited on a low-energy shallow marine platform between the Albian and the Campanian (Estupiñan et al. 2010).

The Napo karst may be considered a shallow one, with direct infiltration of surface streams along lithological contacts such as those between limestones and shales or between different types of limestones. Due to the thinness of the lithological units and their alteration, often “superposed underground streams” are encountered that use different lithological contacts among the same formation. The Castillo Cave has total mapped length of 450 m and three exits-entrances, being a western, a central and an eastern end. The meandering form of the cave is truncated by a river, which flows from north to south. The maximum height in one of the open chambers along the corridors is of approximately three meters. In such chambers rests the highest populations of bats (unidentified species).

One of the entrances of the Castillo Cave is only 60 m in distance of a major paved road in the outside area of Tena city, but the surface karst morphology of the cave is hidden by the dense jungle forest, having the corresponding diverse flora and wildlife. The inner cave fauna include a typical cave fauna: mammals (chiroptera), reptiles, amphibians, arthropods, actinopterygii (Peck 1985, Peck 1994, Romero and Paulson 2001, Hoese G et al. 2015, Toulkeridis et al. 2015).

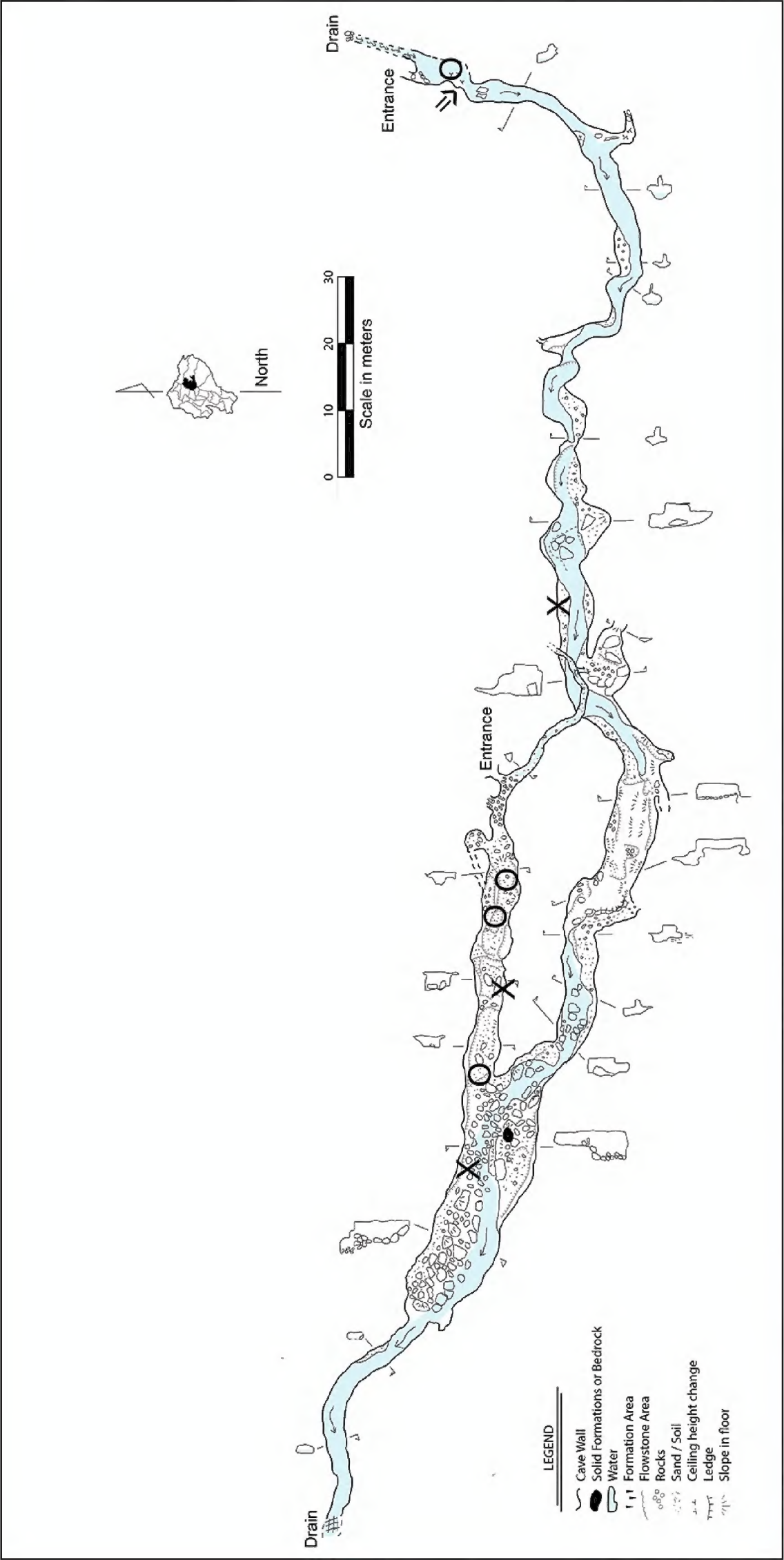


Figure 1. Location of Napo Province and Tena as well as Castillo Cave. Map of Castillo Cave in which circles represent sites where boas have been observed in the floor and crosses where boas have been observed close to the roof of the cave. The easternmost site is the one described in the text.

Results

Observation

In the late afternoon of the 5th of December 2015 as part of the regular cave monitoring we entered the Castillo Cave, outside the city of Tena, where we met a first rainbow boa, *Epicrates cenchria*, some 25 meters inside the side entrance. At 4:50 p.m. local time, we observed the catch and recorded most of the predation behavior of a second rainbow boa the *Epicrates cenchria* on a *Desmodus rotundus* adult female in the Castillo Cave close to the northern exit of the cave. The whole event, from the catch until the end of the meal, took approximately 25 minutes. The recorded part in high resolution corresponds to the final act and is as long as some 16 minutes and is summarized and edited in <https://www.youtube.com/watch?v=amtdKGsT7fU>.

The event occurred as follows: A ~140 cm long *E. cenchria* was waiting with its open mouth around a final corner in the eastern exit of the Castillo cave (Fig. 1) for a prey, having just a fourth of its body some 30–35 cm above ground. A *D. rotundus* flying into the cave in a correspondent low height was caught upfront with its head in *E. cenchria*'s mouth. Almost immediately *E. cenchria* brought *D. rotundus* down to the cave floor, where the body of *D. rotundus* got encircled, having *E. cenchria*'s head up, and way above the prey. Resistance of *D. rotundus* ended some two minutes after the catch. Nonetheless, *E. cenchria* remained in that position for some seven more minutes moving just slowly with the whole body (Fig. 2A). Once being assured, that *D. rotundus* had no more life signals, *E. cenchria* left the dead body on the ground (Fig. 2B) and started to open its jaws in the air for some two more minutes, turning around the head some three times. Then *E. cenchria* tried some five times to bite in different parts of the body to see which part would fit in the mouth best (Fig 2C). Every try and exploration took between 30 to 60 seconds. Finally, *E. cenchria* decided to introduce the head of *D. rotundus* first into the mouth and proceeds to bite with intent to swallow *D. rotundus* by some 11 minutes. During these 11 minutes, *E. cenchria* took out the prey of its mouth the fifth time, while at the sixth time, it lift *D. rotundus* slightly off the ground and turned around the body's prey until supine position revealing clearly its age-sex class (Fig. 2D), which belongs to a non-pregnant adult female. There is no evidence of functional mammary gland that warn us that the prey didn't have a suckling infant. This phase lasted for 2 minutes and 17 seconds. Once the prey was covered, *E. cenchria* try swallowing *Desmodus* body by mandibular detachment and using retractable light movements of its teeth, this intention lasted for 2 minutes and 35 seconds.

Viewing that the prey was too difficult to swallow because of the joint stiffness shoulder, *E. cenchria* begins again the process of constriction (Fig. 2E), for which moves their initial proportion of their body and wraps hardly the prey, this process extend by 1 minute and 2 seconds and immediately begins definitive swallow process until swallowing the whole *Desmodus* with a duration of 4 minutes and 50 seconds (Fig. 2F). The last part to be swallowed has been feet and wings. *E. cenchria* remained in that area for some half an hour, swallowing the bat further inside the body, before it moved away (Fig. 2G, H).



Figure 2. **A** Rainbow Boa (*Epicrates cenchria*) maintains the prey in the mouth with the interest to make sure it is dead, elongated thumb with three typical bearings evidences the species of the Common Vampire Bat (*Desmodus rotundus*) **B** *E. cenchria* releases the dead prey **C** *E. cenchria* turns around *D. rotundus* having the first attempt to swallow prey **D** Evidence of sex-age category of the prey, being a female adult; **E**: Starting the second constriction **F** After the second constriction *E. cenchria* swallows almost entirely *D. rotundus* **G, H** Prey is almost completely eaten except for the wings, but the three typical bearings can be seen on the thumb of *D. rotundus*.

Discussion

Predation of bats by snakes, is not that infrequent (Davis 1951, Steyn 1964, Mankins and Meyer 1965, Thomas 1974, Schatti 1984, Lewis et al. 2009). It is well registered in general websites but few are well documented and published. However reports of *E. cenchria* predating on bats are rare in caves the first record was documented by Lemke (1978), in a cave in Colombia and the second record was registered by Ramos Donato et al. (2012) in a cave in Brazil.

Concerning the prey, they are all, medium sized bats (Greenhall et al. 1983, Lassieur and Wilson 1989, Cloutier and Thomas 1992, Kwon and Gardner 2007).

In Colombia, the bat species was *Carollia perspicillata*, and in Brazil *Lonchorhina aurita*. However, our record is the first to observe the heaviest and largest bat such as *Desmodus rotundus*. In Colombia, there was only one species of bat in the cave, however in Brazil's study they registered also *Desmodus rotundus*, which can implied that *Desmodus rotundus* might belong to their diet too. It is important to notice that *Desmodus rotundus* has a terrestrial locomotion (Riskin et al. 2006) that *E. cenchria* can take advantage because *E. cenchria* was observed several times on the ground (T. T. observations).

The other two studies have not described the process of the event in detail. The predation took place in the three studies during the day but at different moments. In our study, the observation was at 4:50 p.m. For a nocturnal snake and for *D. rotundus*, is almost dusk. And *D. rotundus* can start their foraging activity at different times each day (Wimsatt 1969), and the roost exist can be influenced by human activity or weather. If it is cloudy, the weather during observation, the foraging activity of both individuals can start earlier. The constriction lasted for 4 minutes in Brazil, while in our study it lasted for 10 minutes and 2 seconds. This can be due to the size of *D. rotundus*. Also, in relation to the environment, the caves are located close to rivers which corresponds to the snakes ecology (Gonzálves 2006). Nevertheless, the water of the Castell cave is contaminated with waste water, establishing that the habitat is disturbed. However it appears that both species, *Desmodus rotundus* and *E. cenchria*, are adapted to this environment.

Conclusions

This is the first report for Ecuador, of *Epicrates cenchria* predating on a *Desmodus rotundus*, in a cave, and the third report for Latin America. With such a few reports, we cannot affirm that this kind of predation is common, but we suggest that a detailed study in this population would help us confirmed that this behavior is more than usual.

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